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Transitioning from a Reactive to a Proactive Manufacturing Culture

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Abstract
We often hear or use the terms "World Class Manufacturing" or "Best in Class Manufacturing" in reference to our manufacturing operation or perhaps a competitor's or supplier's manufacturing operation. However no formal industry recognized definition of "world class" or "best in class" manufacturing exists. There certainly are numerous industry recognized evaluation and certification programs such as ISO and the Malcolm Baldrige Award, but do any of these evaluations and certifications anoint a particular manufacturing operation as "World Class" and/or "Best in Class"? If not what is the true measure of a world class manufacturing operation? Of course our customers are the final judges of our performance, but what should we be doing to maximize the satisfaction of our customers?

One of the key factors if not THE KEY FACTOR in attaining world class or best in class manufacturing status is the approach to developing, controlling, and improving the manufacturing process. A true world class manufacturing operation must have a Proactive Manufacturing Operation Culture.

This paper will detail how a manufacturing operation can transition from a reactive manufacturing culture to a proactive manufacturing culture.

Specific issues discussed will be:
- How to recognize a proactive manufacturing culture
- The specific training, management, and organizational issues that can make this transition successful.
- Who must be involved?
- How to get started?
- What are the specific actions that must be completed to achieve the transformation?
- How to institutionalize (maintain) a proactive manufacturing culture?
- What are the process performance benefits of a proactive manufacturing culture?

Introduction
A proactive manufacturing culture can be the "secret weapon" in gaining a competitive advantage in the electronic manufacturing industry. Virtually all the electronic manufacturing operations in the world can purchase the same process equipment, inspection and test systems, software products, computers, facility controls, material handling and ESD control products, etc. What is it that separates one operation from another? It is not any piece of equipment, software, etc. It is the manufacturing culture. It is how the organization utilizes all the resources it has. Whoever best utilizes its resources will have a competitive advantage.

More than ever productivity and quality are important to a successful manufacturing operation's performance. Most manufacturing operations no longer have the luxury of high margin products to absorb inefficient processes and poor quality. The improvement in revenue and the resulting profit even from seemingly small improvements in quality (first pass yield) and cycle time can be dramatic. Organizations that have sophisticated quality, cycle time, and costing systems can easily calculate the benefits of a 1% reduction in defects and/or a 1% improvement in cycle time. A manufacturing operation manager should calculate the benefits of seemingly insignificant improvements to determine what improvements should be focused on and what is the specific magnitude of those improvements when they are implemented. Often these improvements can be achieved with minimum investment.

I have visited many organizations in various regions of the world that frequently focus their process improvement efforts on the latest innovation in equipment technology, materials technology, software, inspection technology (AOI), etc. While I certainly agree that these innovations in equipment, materials and inspection capabilities are a benefit to any operation, I feel strongly that a very significant opportunity for process improvement is not being utilized. This opportunity for process improvement is the "manufacturing culture".

What is Manufacturing Culture?
Culture is a collection of customs, rules, laws, behavior, values, traditions, etc, that define what is acceptable and correct and what is not. Culture also dictates how we do things. We know that in many instances there are a number of ways to accomplish a goal or task. What makes us choose a certain method to get something done? In many cases it is our culture.

We certainly understand regional and geographical cultures. The culture of a region or country drives the beliefs, goals, values, and behavior of that region or country. One of the pleasures of traveling is to enjoy (food, behavior, dance, dress, customs, festivals, etc.), learn, and hopefully understand the cultures of various regions and countries. The world would be a much less interesting place if we all had the same culture. We enjoy and celebrate the diversity of cultures around the world.

Manufacturing cultures have to be considered in an entirely different light. There certainly can be variation in how a process is designed, how it is organized, what equipment is used, etc. However there is very little variation in culture that can be tolerated in the area of process monitoring and control, problem solving, and product quality. Does the existing manufacturing culture drive disciplined, well planned, and effective approaches to problem and defect prevention, or does it move from one day to the next continually addressing the same issues and problems? One culture will provide the optimum results and the highest probability of satisfied customers. The other culture will results in “good days” and “bad days” and customers that are continually looking for more consistent results and eventually for other suppliers.

There are only two basics cultures that a manufacturing operation can have, a reactive manufacturing culture or a proactive manufacturing culture. The most obvious way to determine the type of culture that exists in a particular operation is to identify if the process or the product is being monitored. If the product is being monitored then inevitably the culture is a reactive culture. Defects are created and the emphasis is on finding them. If the process is being monitored, inevitably the culture is a proactive culture where the focus is on preventing defects before they happen.

Proactive Manufacturing Culture
A proactive manufacturing culture has several very distinguishable traits. First and foremost the focus is on **PREVENTING DEFECTS** before they happen. Another key trait of a proactive manufacturing culture is **never slowing down the process** improvement efforts. There is a well-established continuous improvement program with specific quantifiable goals. There is no final destination along the road to quality and cycle time improvement. It is a continuous cycle that must always have new goals and plans that support achieving those goals.

The people working in this manufacturing are well trained in process development, statistics, problem solving, project management, and design for manufacturability (DFM). They understand what their customers require and what improvements are required to maintain the highest level of customer satisfaction. They feel they are an integral part of the operation and what they do has an impact on the health of the business.

Several other traits of a Proactive Manufacturing Culture are:
- A proactive manufacturing culture will invest in training its operators, supervisors, managers, engineers, and technicians in SPC, Design of Experiments (DOE), Design for Manufacturability (DFM), Problem Solving, etc.
- A proactive manufacturing culture operation is one that has completed formal experimentation (DOE) and studies to identify and quantify the critical operating parameters and is using statistical tools such as Statistical Process Control (SPC) to monitor the process.
- A proactive manufacturing culture will react to process “out of control” situations with timely effective corrective action.
- A proactive manufacturing culture will monitor the process to PREVENT defects, not attempt to find defects that have been created by inspecting the assembled product.
- A proactive manufacturing culture has minimized non-value added activity such as in process inspection.
- A proactive manufacturing culture is focused on using timely data to drive continuous improvement.
- A proactive manufacturing culture is NOT solving the same problems every day.
- A proactive manufacturing culture will involve all functions in the operation to “brain storm”, evaluate, and implement effective process improvements.

Identifying Your Manufacturing Culture
How do you evaluate what manufacturing culture exists in any particular manufacturing operation? The following is a list of general questions that you should consider in evaluating your particular operation. Think about what happens day to day in your operation.
- Is your organization focused on preventing defects or finding defects?
- Are you an “expert” at preventing defects or finding defects?
- Do you have “control” of your process or does your process have “control” of you?

- Are you regularly discovering the "root cause" of problems and implementing permanent corrective actions?
- Do you have a formal "problem containment plan" that effectively insures defects are not escaping to your customers while you identify the problems "root cause" and implement the permanent corrective action?
- Is every day a day of crisis management?
- Are you solving the same problems every day?
- Do you train and "coach" your operators, engineers, technicians, supervisors, etc. on understanding the entire process and how to identify and solve problems?
- Do you use formal statistical tools (DOE) to identify and quantify critical operating parameters?
- Do you use formal problem solving tools to solve problems?
- Are the solutions and corrective actions being institutionalized?
- Are you seeking and using all available information and input from all levels of the organization including suppliers and customers to develop the optimum solutions to problems?
- Do you know how your process is performing at any particular time?
- Are you too busy to use formal tools in developing and implementing processes and solving problems?
- If so what are you too busy doing?
- Is the manufacturing operation organized in the most efficient manner to provide the correct resources to the correct need in the shortest possible time?
- Does the entire manufacturing organization have both organizational and personal goals that will continually improve the operation's performance and satisfy customers?
- Are these goals supported, coached, and reviewed by management on a regular basis?
- Are customer feedback and suggestions used to drive corrective actions and process improvement projects?
  - What does the customer want?
  - What wins you business over your competition? ("Winning Order Criteria")
- Do you have specific detailed measurable process improvement goals and the projects to achieve those goals?
- Have you identified the most critical elements of your operation that must be evaluated and measured to insure it is performing at an optimum level?
- What are the standards (metrics) for evaluating how well your manufacturing operation is performing?
- How do you evaluate what improvements should be implemented to provide the largest possible return?
- How do you use this information in the creation of a continuous improvement program?
- How do you know if the improvements you implemented were effective and achieved the predicted results?
- What do you do to move to the next level of manufacturing operation's performance?

The following is a list of more detailed questions and observations that also can be used in determining your manufacturing culture

1. **Do all of your process engineers know how to run all of the process equipment?**
   This may sound like a silly question. However, we have experienced manufacturing operations that have engineers responsible for equipment and entire process lines that they have not been trained to operate. They cannot understand, let alone correct basic problems if they have not been trained to operate the equipment. This is like sending a solder into battle without a weapon. No matter how hard he fights or how hard he works he will lose the battle.

2. **Does the engineer responsible for the stencil printer know how to design a stencil?**
   One of the key components of the printing process is the stencil. Understanding stencil design is vital to insure an optimum printing process. The process engineer must know the basics of aperture ratio, area ratio, home plate design, etc.

3. **Do you have a well thought out SPC program and use the data effectively?**
   The benefit of an effective SPC program is to stop defects from happening as opposed to finding defects that have been created. By continually monitoring the performance of the process we can stop "out of control" situations from occuring. SPC is one tool in a "Proactive-Manufacturing Environment". Finding defects after they happen is a "Reactive-Manufacturing Environment".

4. **Do you have a continuous improvement plan?**
   The manufacturing organization must be continually evaluating its performance data to drive improvement. If data is being collected and not used to drive improvement, the collection of the data is a "waste of time".
   Management must be committed, involved, and supportive to the continuous improvement program. Definitive quantifiable goals must be determined and monitored.

5. **Does the process engineer in charge of component placement assure that the high-speed placement machine and flexible placement machine are cycle time balanced?**
Significant process capacity and process cycle time reduction can be achieved by insuring the placement equipment's cycle time is balanced.
In most operations the placement process cycle time determines the cycle time of the entire process line. If one placement machine cycle time is longer than the others an analysis should be done to determine how to balance the cycle times.

6. **Does the process engineer in charge of the reflow process know how to assure that the reflow profile matches the solder paste specification?**
The flux in solder paste is a complex product. It needs to experience specific heat for specific times to properly perform the jobs it was designed to do. A process engineer must read and fully understand the solder paste specification's temperature and time requirements when creating a reflow solder profile**.**

7. **Do the process engineers know the difference between special cause and common cause process variation?**
In our experience this difference is one of the most misunderstood concepts in our industry. Common cause variation is a normal unidentifiable process variation. It is expected and within specification so it does not need to be fixed. Occasionally common cause variations taken together can cause a failure, but the failure rate should be within the SPC limits (i.e. typically very low). Special cause variation is a one-time identifiable process variation; something has changed and is "out of spec." Adjustments to a process should never be made for special cause variation. Special cause process variation must stop the process, be identified and corrected before the process is allowed to start.

8. **Does the process engineer in charge of the wave solder process know how to assure that the wave profile matches the flux paste specification?**
Flux is a complex product. Flux and the PWB it is on, need to experience specific temperatures for specific times in order to properly perform the job it was designed to do. A process engineer must read and fully understand the flux specification's temperature and time requirements when creating a wave soldering profile**.**

9. **Do the process engineers understand the basics of design for manufacturability (DFM) and negotiate DFM issues with customers?**
The process engineers must understand the requirements of "good" product design. They must be able to work with the both internal and external customers to optimize the product design.

10. **Do the process engineers understand and apply simple design of experiment concepts (example: identifying and optimizing each machine and the lines critical operating parameters) and know how to use Minitab or similar software to analysis the DOE data?**
Design of Experiments (DOE) is a powerful tool in optimizing a manufacturing process. It is the only method available to identify and quantify critical operating parameters. Process engineers must understand and use DOE in developing and optimizing their manufacturing processes.

11. **Do the process engineers know how to solve problems systematically with formal analytical problem solving techniques?**
Even the most complex manufacturing problems can be solved using systematic, analytical problem solving methods. These methods include teaming, numerous problem-solving tools (pareto charts, affinity diagrams, brainstorming, etc.), and the use of manufacturing performance data.

12. **Do you know your average process uptime?**
This may also sound like a silly question. However, some operations do not have a system that accurately measures and monitors process uptime. There are also many definitions of what process uptime is. Any time your line is producing product, it is uptime. Any time the line is not producing product for any reason it is downtime. All downtime is bad. However, some downtime is necessary, such as set up time and preventative maintenance. Every effort should be made to minimize any cause of downtime.

13. **Do you know your average line unscheduled downtime?**
The importance of knowing your average unscheduled downtime is to understand how much production time you are losing, but more importantly, it is to understand the causes of the unscheduled downtime. This information should create unscheduled downtime reduction goal for the process engineer.

14. **Do you know your average line efficiency?**
Line efficiency is how well your line is producing products versus the target production rate. If your target rate is 50 units per hour you should know how close to or better than 50 you are producing. This information must be available in "real time" to allow corrections and adjustments to the production rate.

15. **Do you know your inventory turns per year?**
The vast majority of the value of an electronic product is in the material. Turning material into revenue as quickly as possible is vital to being competitive. Inventory turns should be closely monitored. Increasing inventory turns should be a goal for the entire manufacturing operation.

16. **Do your engineers have a disciplined and proven strategy to minimize setup time?**
Set up time can be a major drain on available production time. Set up reduction teams led by process engineers should be continually working on methods to reduce the time to set up and change over the process.

17. **Do your engineers have a disciplined and proven strategy to maximize throughput?**
There are two ways to increase process capacity. One is to acquire more resources (people, equipment, building, etc.). The second is to produce more with what you already have. In addition to reducing process defects, the process engineers should be focused on producing more with what they have.

18. **Do you have a comprehensive quality improvement plan and do you know the capability (Cp and Cpk) of every process?**
The operation must have a proactive plan that is focused on eliminating defects. This plan must be formal, very well defined, clearly understood by all, and have absolute management endorsement. The responsible individuals must be given the authority and resources required for them to achieve their assigned goals.

19. **Do the process engineers have a specific, quantifiable defect reduction goal?**
Process engineers must have clearly defined improvement goals that will support the operation's improvement goals. Individuals and teams working on very specific improvements achieve defect reduction. The engineer's specific improvement goal should be within his power and ability to achieve.

20. **Is the process engineer's yearly performance review based primarily on cycle time and defect reduction goals?**
Process engineers' performance reviews should be primarily based on how well they achieved their defect and cycle time reduction goals. There are certainly other measurements to judge a process engineers performance, however the bulk of the engineers work during the year must be focused on cycle time and defect reduction. These goals must be clear, definitive, and measurable.

21. **Is it true that the operators do not have access to the equipments operating parameters?**
Operators should never under any circumstances have access to the equipments operating parameters (speeds, temperatures, pressures, etc.). If the operation allows the operators to adjust the critical operating parameters of the process equipment the process is "out of control". Operating parameters that have been determined using analytical engineer methods will produce the optimum results. If these operating parameters are no longer producing the desired results that is special cause variation. The source of the special cause variation must be investigated and corrected.

22. **Do you have a problem escalation policy that is used and understood by all?**
When a problem does occur everyone in the operation should know who is responsible for investigating and correcting the problem. The first person responsible for correcting the problem must know how long they should work on it prior to notifying the next person on the problem escalation list. This policy must be strictly adhered to in order to minimize process down time and other problem resolution delays.

23. **Do the process engineers use sophisticated process modeling tools to design their processes and to do "what if" analysis?**
Process design, capacity analysis, and cycle time improvements can be evaluated using sophisticated process modeling tools. These tools are the best method to precisely determine what process design best suites the manufacturing goals. Once the model is constructed and verified, it can be used to perform "what if" analysis such as the benefit of a faster placement machine or the addition of another operator.

24. **Is there a process engineer or team of process engineers assigned to learn, plan and implement new technology?**
    An individual or group must be assigned to investigate, learn, and implement new technologies. New technologies must be fully understood through experimentation prior to introduction into the manufacturing operation. The manufacturing organization that waits until "the last minute" to learn and implement a new technology will be creating costly defects on revenue producing products.

25. **Does the operations/production manager have all of the required resources necessary to achieve production goals reporting to her/him?**
    The production manager must have all the resources she/he needs to achieve the organization's goals. Many times organizations have vital resources reporting to several different people. This can, and usually does, result in delays in resolving problems and improving the process due to bureaucratic issues and conflicting goals. There must be a very focused organization with clearly defined goals that are measured to insure maximum efficiency.

The Process of Transitioning from a Reactive to Proactive Manufacturing Culture
Now that you have evaluated your organization and are considering commencing its transition from a reactive to a proactive manufacturing culture the next questions is how to do it. The transition process can be and most likely will be a long process that will require the absolute active participation of management and a great deal of dedication and work from many people. I certainly do not intend to detail all the individual tasks that will be required since what will be required will differ from organization to organization depending on their current manufacturing culture.

Members of the existing manufacturing organization can certainly manage the transition process. However many times an outside resource such as an industry consultant or an experienced person from another division or location of the company can be very effective in managing the transition process. The outside person can present an objective analysis of the operation and bring hers/his experience in managing similar transitions.

Manufacturing System
In transitioning from a reactive to a proactive manufacturing operation culture first we must consider our operation as a "Manufacturing System". If we consider our manufacturing operation as a "system" we will insure that we are considering all the areas and issues that must be evaluated. It provides little benefit to concentrate on one portion of the "manufacturing system" if we are truly committed to implement a "proactive manufacturing culture"
What is a manufacturing system?

A manufacturing system is defined as "The collective plans, activities, and events that are provided to ensure that products, processes, and services will satisfy given customer requirements". The key point in considering a manufacturing operation is to evaluate it as a system. ALL the factors that impact the output of the manufacturing system must be evaluated. The formal consideration and classification of the manufacturing system must include all activities that will influence the cycle time and yield of the process.

If we assume that cycle time and yield are the dominant goals of any electronic manufacturing process, no matter where it is located and no mater what product is being produced, then any and all activities in that manufacturing process should be focused on improving them.

As Eliyahu Goldratt states in his book <u>The Goal,</u> "The goal of all business is to make money now and in the future". In electronic manufacturing, assuming we have viable, desirable, competitive products, the way to make money now and in the future is to continually improve cycle time and yields.

There are certainly other manufacturing systems goals that focus on environmental issues, safety issues, housekeeping issues, new technology and product introduction, training issues, etc. However, no manufacturing operation can stay competitive if it does not continually strive to improve its cycle time and yield. The goals of the people that support the process should be focused on yield and cycle time improvement. These are the goals that should influence their compensations and or advancement opportunities.

As stated, a manufacturing system includes all factors and areas that impact the performance of the operation.
1. Process Development
2. Process Control
3. Process Design
4. Process Layout
5. Process Flow

6. Process Line Balancing
7. Process Optimization Program
8. Process Tooling and Fixtures
9. Process Technical Support
10. Process Documentation and Documentation Control
11. Process Capacity versus Required Capacity
12. Process Scheduling and Job Sequencing
13. Process Set Up and Change Over Procedure
14. Operator Responsibility, Training, and Efficiency
15. Relating Process Goals to Personal Goals
16. Management Process Support and Performance Review
17. Supplier Relationships
18. Material Control
19. Material Flow and Availability
20. Material Handling
21. Preventative Maintenance Program and Schedule
22. Calibration Control and Schedule
23. Continuous Improvement Program and Goals
24. Industry and Process Benchmarking Program
25. Product Design For Manufacturing Review Process
26. New Product Introduction Process
27. Model and Prototype Process and Scheduling
28. Engineering Change Order Process
29. Environmental Requirements and Control
30. Critical Process Parameter Development and Control

Often a manufacturing operation does not view itself as a “system”. It is organized with different individuals responsible for different portions of the “system”. Many times this organizational structure creates conflicting goals. For example if one of the materials people’s key goals is inventory turns, a situation may occur that all the materials required for a specific product may not be available when the production manager is scheduled to build that specific product because the material is not scheduled to be delivered until the last possible moment. This will cause production delays and increased process changeovers. The cost of most electronic products is 70% or more in the material. Controlling material and inventory is important. However how quickly a company turns material into revenue should be a measured. Often production lines are idle during regularly scheduled work shifts because of the lack of material. The work has to be completed on more costly overtime shifts when the material is available.
Again from Goldratt’s book The Goal, “All individuals that have responsibility for the manufacturing system should be measured on the same goals. The goals should be focused in three areas only”;

- Decrease Operating Expense
  - ✓ Operating expense is, “All the money the systems spends in order to turn inventory into throughput”.
- Decrease Inventory
  - ✓ Inventory is, “All the money that the system has invested in purchasing things it intends to sell”.
- Increase Throughput
  - ✓ Throughput is, “The rate at which the system generates money through sales”.

If the managers and workers responsible for the manufacturing system shared these three goals then the best possible decisions could be made. Manufacturing improvement goals should be developed from a manufacturing system perspective.

When considering and classifying an electronic manufacturing operation it is just as important to understand the organizational structure, goal setting process, and continuous improvement program as it is to understand how the screen printing or wave soldering process is operating.

Steps in the Transitioning Process
The initial activity is to use the questions listed to evaluate your manufacturing culture. You should consider both your strengths (in what areas are you doing well?) and what requires improvement to transition to a proactive manufacturing culture. Once you have identified what is required you can embark on the steps required to initiate and complete the transition.

Step One
The first step in the transition from a reactive to a proactive manufacturing culture is active management support and total commitment. As in almost all things that are implemented and institutionalized in a manufacturing organization or any organization for that matter, management has to be totally committed to make this transition happen. Management's active participation is committing not only the required resources but also their experience, advise, guidance, and support in reviewing the progress of the transition teams on a regular basis. Management must be prepared to listen, advise, coach, and reward the transition teams.

If management is not interested or only partially interested this transition will not happen. A culture, no matter what that culture is, has to be supported either actively or passively by management. If management is satisfied with the existing culture and will not support the necessary resources for change then the existing culture will continue. Certainly individuals can "make a difference" in implementing process improvements, however transitioning the entire culture of a manufacturing organization can only be accomplished by total active management commitment.

The first step in gaining managements support and active commitment is to develop improvement plans with heir estimated benefits. What should be done and what is the benefit of that action? This process should not be an exercise in very detailed cost estimating. It should be more of an exercise on "sizing the job". What are the tasks, what resources are required, how long will it take, and what are the benefits? Use your experience, information from industry sources, suppliers, customers, team members, consultants, other divisions of your company, etc. to acquire the information you need to estimate the benefits of a proactive manufacturing culture.

Step Two
Training, Training Training Training………!!!!
There is no substitute for a well-trained staff of operators, engineers, technicians, supervisors, etc. The training programs must include the process itself in all its detail, problem solving skills, statistics, project management, Design for Manufacturability, etc. The exact programs and details of those programs must be appropriate to support the goals and responsibilities of that particular level of the organization.

Management must give every individual the "tools" (training) required to maximize their effectiveness.
We must think of training as an investment requiring funding and with a return on that investment (ROI). We can certainly understand investment in the equipment, tools, software, facilities, etc., required to produce products. We know that these investments are vital in producing a profit and will over some time return the investment many times over. Why should we not think of training in the same manner?

Step Three
Once you have gained management approval of your transition plan, work with your team to develop specific schedules, detailed goals, and regular meetings with management to review your progress. Use your initial evaluation of your organization to identify exactly what is required. You now need to break down the requirements into specific tasks.
The transitioning plan must include specific quantifiable goals for individuals, teams, departments, and the entire organization. The plans and goals must be coordinated to insure all the activities in your particular organization to achieve the transition are being addressed. Assign individual action items and goals.

Step Four
Coach, manage and execute the transition plan. As we discussed in step one, management must be **active** participants in the plan**.** The "coaching" activity is a very important aspect of a successful plan. Management must use their experience and resources to guide the team over and/or around whatever obstacles or difficulties they encounter. Management must also continually monitor the progress of the teams and work with them on calculating the benefits of their work.

When the plan or a portion of it is implemented and the benefits are calculated "celebrate the success". This celebration should be some form of recognition to the team and/or individual who achieved their specific goals. The celebration emphasizes to the entire organization the manufacturing culture that is valued, supported, and expected by management.

Conclusion

A proactive manufacturing culture can be the “secret weapon” in gaining a competitive advantage in the electronic manufacturing industry. Virtually all the electronic manufacturing operations in the world can purchase the same process equipment, inspection and test systems, software products, computers, facility controls, material handling and ESD control products, etc. What is it that can separate one operation form another? It is the manufacturing culture.

A manufacturing culture is certainly not easy to identify and its benefits are not easy to quantify. However we certainly can understand and calculate the benefits of reducing defects, improving cycle time, minimizing rework and scrap, all the normal manufacturing metrics etc. The manufacturing culture is the instrument that will drive the behavior that will optimize the manufacturing metrics.

The transition to a proactive manufacturing culture is NOT easy. It requires a great deal of work. But it is the only way to truly make measurable, meaningful, long-term improvements that will keep the operation competitive and most importantly result in customer satisfaction in a very competitive electronic manufacturing industry.